U.S. Participation in the Large Hadron Collider at CERN
An Investment to Maintain U.S. Scientific Leadership

Through the U.S. Department of Energy and the National Science Foundation, the United States will invest $531 million over the next eight years in a new particle accelerator, the Large Hadron Collider, to be built in Geneva, Switzerland. The U.S. is one of several non-CERN-member nations, including Japan, Canada and Russia, contributing to the LHC. Why does this investment make sense for the United States?

The U.S. is a world leader in High Energy Physics.
Today and for the next several years, the Tevatron, the world's highest-energy particle accelerator, at the Department of Energy's Fermi National Accelerator Laboratory, represents the energy frontier for research and discovery in particle physics, the science of the fundamental nature of matter. The nation's investment in the Tevatron provides unsurpassed opportunities for discoveries now and in the opening years of the new millennium. But when the LHC begins operating sometime after 2005, the U.S. will no longer have the highest-energy particle accelerator. The LHC provides a cost-effective opportunity for U.S. scientists to continue to work at the energy frontier—and to develop the technologies for building the accelerators that will someday follow the LHC.

After 2005, the energy frontier will move to the Large Hadron Collider.
The LHC is a new particle accelerator, 16 miles in circumference, to be built at CERN, the European Laboratory for Particle Physics, near Geneva, Switzerland. It will reach the highest energy yet achieved by any particle accelerator—about seven times the energy of Fermilab's Tevatron. Physicists will use the LHC for the next generation of experiments to explore the fundamental nature of matter.

U.S. Involvement in LHC
- When the energy frontier moves from Fermilab's Tevatron to the LHC after 2005, about 25 percent of U.S. experimental particle physicists will participate in physics experiments at the LHC.

- U.S. physicists from six national laboratories and 60-plus universities will collaborate in developing and constructing the LHC accelerator and its two major detectors, ATLAS and CMS..

Accelerator Construction
- The U.S. will participate in LHC accelerator construction at a cost of $200M over nine years, about five percent of total accelerator construction costs.

- Of the $200M in U.S. accelerator funding, about $90M will be spent domestically for goods from U.S. industry.

- The remaining $110 M will pay for design and fabrication in the U.S. of advanced accelerator systems by a collaboration of three U.S. national labs: Fermilab, Brookhaven, and Berkeley Lab.

- Worldwide collaboration in accelerator construction allows the machine and the science to benefit from the use of the best talents from all regions of the world.

Detector Design and Construction
- The U.S. will participate in design and construction of two large LHC experiments, CMS and ATLAS, at a cost of $331M over eight years, about 20 percent of the total construction cost of these experiments. $250M will come from DOE and $81M from NSF.

- These funds will be used to support researchers at U.S. universities and national laboratories to design and build state-of-the-art detector systems.

- More than 500 scientists from over 60 U.S. universities and six national laboratories have joined the U.S. CMS and ATLAS collaborations. Fermilab is the host laboratory for the U.S. CMS effort; Brookhaven National Laboratory is the host laboratory for the U.S. ATLAS activities.

U.S. Collaboration in the LHC Returns on the Investment

Collaboration in the LHC project makes sense for the U.S. because of the quality of the science, the technical strength of the project, and the terms of the agreement.

Scientific quality

- The science at the LHC is compelling; it represents the next generation of discovery in the search to understand the fundamental nature of matter. Participating in the LHC will help the U.S. remain among world leaders in the science of high-energy physics.
- Collaboration in the LHC will advance U.S. capability in forefront technologies, such as superconducting magnet design, that are critical not only for the LHC but for the U.S. accelerators of the future.
- U.S. participation in the LHC has been strongly endorsed by the Division of Particles and Fields of the American Physical Society, the High Energy Physics Advisory Panel to DOE, the special NSF panel on Elementary Particle Physics, and the National Science Board.

Technical strength

- Participation in the LHC project will strengthen the domestic research program by keeping U.S. universities and national laboratories involved in cutting-edge research. The design studies, development of detector and accelerator systems, and the research at the LHC will advance the skills of U.S. physicists and engineers and enhance the infrastructure within the U.S. labs.
- CERN is a strong and reliable partner. Like the U.S., CERN is also a world leader in high-energy physics. CERN has an excellent 40-year record of accelerator and detector construction, including the accelerator that now occupies the tunnel that will house the LHC.
- About 25 percent of American experimental high energy physicists plan to do research at the LHC. Twenty percent of the physicists who are working on constructing the two large experiments are U.S. scientists.

Terms of the agreement

- The LHC will be a highly cost-effective way for the U.S. to continue to do forefront high-energy physics research. The cost to the U.S. will be about 10 percent of the total LHC accelerator-plus-experiment cost, whereas U.S. researchers will make up about 20 percent of the users of the two major detectors.
- Of the proposed $450M U.S. contribution to CERN by the Department of Energy and $81M from NSF, almost all will be spent domestically on the purchase of goods and services from U.S. industry and for U.S. wages and salaries.

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